

Extending ‘environment-risk weighted assets’: EU taxonomy and banking supervision¹

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Abstract

Last months marked a significant change in the mass perception on the need to tackle climate change. The world is becoming aware of how quickly and radically the economy must be transformed to meet the goals posed by the Paris Agreement. It is also increasingly clear that financial system must be engaged in full to help the transition to the green economy. There is a wide debate about proposals on how to involve the financial sector in the transition, included banking regulation. Recently we suggested to use “environment-risk weighted assets” to internalize the pollution risk of the borrower (Esposito, Mastromatteo and Molocchi, 2019). In this paper we build on this framework with two main aims. The first is to complete its empirical application by adopting external cost calculation to estimate both direct and embodied (direct and indirect) external costs of air emissions of NACE sectors, in order to make a calculation of the “external costs footprint” of Italian corporate lending and to discuss the pros and cons of the two methods. The second is to complete and refine our policy proposal, taking into consideration the discussion on the EU taxonomy on environmentally sustainable activities and widening the proposal from corporate to consumer lending and securities, thus covering virtually every part of banks’ business, so that its application could be the most business model neutral possible.

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1. Introduction: social climate on climate change is changing

Last months marked a significant change in the mass perception on the need to tackle climate change. The world is becoming aware of how quickly and radically the economy must be transformed to meet the goals posed by the Paris Agreement (the so called “COP 21”). It is also increasingly clear that financial system must be engaged in full to help the transition to the green economy. There is a wide debate about proposals on how to involve the financial sector in order to increase mobilization of private resources as well as public ones to favor the green transition, especially because ordinary economic policy tools have many limits and public finances have been left exhausted by the financial system bail out after 2008.

Europe is at the forefront of the fight against climate change, having put sustainability at the core of its development strategy. Tools like the Capital Markets Union Action Plan, the EU 2050 long term climate strategy (“A clean planet for all”, EC, 2018a) and the Commission Action Plan on financing sustainable growth (EC, 2018b) are examples of the efforts put up by European institutions.

Although multiplied in recent years, public proposals on the transition remain at a very initial stage. This is also true for banking regulation, that, as for now, deals with transparency, governance but not on ways to stimulate banks to reallocate funding towards the green economy (see for instance, the High Level Expert Report of the EU: EU, 2018). From their parts, large financial conglomerates often tend to use green finance as a marketing tool without any real effort to change their business model (so called “greenwashing”; see for instance Warmerdam *et al.*, 2015).

2. How to move the discussion forward

To push the discussion towards practical proposals, in Esposito, Mastromatteo and Molocchi (2019, from now on EMM) we recently suggested to use a tool called “environment-risk weighted assets” (ERWA) that can internalize the pollution risk of a borrower into his/her credit rating. This can be obtained using a correction for the environmental risk in the ordinary prudential weighting of the financial assets:

$$(1) \quad e_i = c_i r_i a_i$$

Where:

- a is the book value of the asset;
- r is the weight assigned to the asset according to the present framework for banking regulation;
- c is the pollution coefficient representing the environmental impact (the negative externality) associated to the asset;
- i is the sector of the asset.

For enforceability reason, we suggested to put c_i value between 0.5 and 1.5, with 1 being the benchmark value assumed as the threshold between brown and light-green activities and where the minimum weight is only assigned to truly green economic activities, that is economic activities able to produce zero or *positive* environmental externalities (economic activities specifically aimed to the reduction of external costs).

To take the example we made in EMM, a € 100 loan weighted 100% in the RWA framework to a firm that has a pollution coefficient of 0.9, yields an ERWA of € 90. For the time being, lacking regulatory reporting on single credit lines, we suggested to apply ERWA to economic activities by applying a *sectoral approach*, based on the NACE classification system. We suggested three ways

to build ERWAs at sectoral level (direct CO₂ emissions; direct external costs of all main air emission types; direct and indirect emissions or external costs obtained by applying Input-Output analysis, IOA), concluding that, theoretically, the most complete approach is the one that combines external costs with IOA in order to consider both direct and indirect health and environmental impacts along the whole production chain of each sector.⁵

We have also made a first tentative application of the ERWA proposal to Italian data using the second (direct external costs) and the third approach (IOA CO₂ emissions) with the available environmental data. Unfortunately, no data were available for external costs embodied in final demand, related to both direct and indirect air emissions in all production sectors activated by demand in each sector.

This paper aims at expanding the ERWAs concept in two main directions. The first is to complete their empirical application by adopting external cost calculation to estimate both direct and embodied (direct and indirect) external costs of air emissions of NACE sectors, in order to make a calculation of the “external costs footprint” of Italian corporate lending and to give a comparison of the pros and cons of the two methods. The second is to complete and refine our policy proposal, through consideration of the policy developments in sustainable finance related to the EU taxonomy and through the step-up of the proposal from corporate lending to cover virtually every part of banks’ activity so that its application could be the most business model neutral possible.

3. Comparison of two different approaches to ERWA based on external cost approach and input-output analysis

This section is devoted to an empirical application of the environmental external costs method to calculating ERWAs for Italy following two alternative approaches: direct external costs related to the sectors’ activities (“DECSA”) and external costs embodied in sectors of final demand (“ECFiD”), to make a comparison. The first set of external cost data has been calculated in relation to emissions directly due to the underlying economic activities, while the second refers to emissions produced along the whole production chain: it represents the health and environmental costs “embedded” in a certain product when it is purchased by the final consumer.

For both approaches we use 2015 data (from Molocchi, 2019) calculated from official accounting sources and methods under an integrated environmental-economic accounting framework. More in detail, this source estimated the air emissions external costs related to production NACE sectors in Italy by applying NAMEA air emissions account (Istat, 2018) and the Italian official guidelines for the evaluation of external costs related to green-house gases and air emissions (MIT, 2017); it then estimated the external costs embodied in sectors of final demand by using IOA and OECD input-output tables for Italy.⁶

Table 1 shows the list of NACE sectors covered by the analysis⁷ (first column), the external costs data used for the two approaches⁸ (second and third column), the results for the two types of

⁵ The main features of the external costs approach as compared to one based on CO₂ emissions only are the following: a) it covers a much wider set of pollutants (about twenty air pollutants, CO₂ emission included); b) it offers an aggregate monetary valuation of the various health and environmental risks related to the pollutants emitted by the borrower, due to its economic activity; c) given that this approach is used also for establishing optimal environmental taxation levels (marginal external costs), the calculated sectoral external costs can be a good estimation of the so called “policy risks” type of transition financial risks (costs related to a new environmental regulation, such as pollution taxes).

⁶ See the OECD website: https://stats.oecd.org/Index.aspx?DataSetCode=IOTSI4_2018.

⁷ The OECD input-output tables refer to 36 branches of economic activity according to ISIC rev. 4 (International Standard Industrial Classification of All Economic Activities), that are consistent with the European NACE rev.2 classification.

⁸ We point out that the external costs obtained using the two approaches cannot be compared, because in the first one the external costs are divided by the sector’s *value added*, while in the second one the external costs are divided by the sector’s *value of final demand*. The latter have been obtained by applying the Leontiev method of the “inverse matrix”, that is based on the direct external

ERWAs (fourth and fifth)⁹ and the sectoral loans at the end of 2015 (last column) that allows the calculation of the “external costs footprint of lending” in Italy, measured as the average of specific external costs weighted by the sectoral share of loans. From the data we conclude that:

- for both ERWAs approaches, lending tends to be allocated to sectors with higher external costs than the average (in fact the average external costs results € 67/€1,000 for lending as compared to € 35/€1,000 for economic activities with the direct external cost approach; € 50/€1,000 for lending as compared to € 38/€1,000 for economic activities with the embodied external cost approach);
- in the second approach this difference shrinks because the input-output approach takes into account the external costs related to each sector’s supply chain (the specific external costs of non-primary industrial sectors and of tertiary sectors are much higher with the IOA).

Table 1: DECSA and ECFiD ERWA for Italy, 2015

NACE Sectors	Direct external costs related to 1 euro of sector's value added	Demand embodied external costs related to total production activated by 1 euro of sector's final demand	DECSA ERWA	ECFiD ERWA	Loans
	€/€, 2015	€/€, 2015	2015	2015	€ Million, 31/12/2015
D01T03: Agriculture, forestry and fishing	0.320	0.217	1.142	1.179	44,347.52
D5T9: Mining and quarrying	0.118	0.079	1.042	1.041	3,177.91
D10T12: Food products, beverages and tobacco	0.035	0.077	0.990	1.039	31,355.50
D13T15: Textiles, wearing apparel, leather	0.014	0.032	0.697	0.916	22,156.64
D16: Wood and products of wood and cork	0.033	0.053	0.973	1.015	*
D17T18: Paper products and printing	0.071	0.062	1.018	1.024	9,703.68
D19: Coke and refined petroleum products	0.971	0.123	1.468	1.085	5,630.30
D20T21: Chemicals and pharmaceutical products	0.173	0.066	1.069	1.028	10,374.19
D22: Rubber and plastic products	0.014	0.041	0.700	1.004	11,116.88
D23: Other non-metallic mineral products	0.457	0.205	1.211	1.167	12,255.60
D24: Basic metals	0.280	0.107	1.122	1.069	14,728.49
D25: Fabricated metal products	0.007	0.040	0.603	1.002	27,793.66
D26: Computer, electronic and optical products	0.008	0.027	0.610	0.855	4,925.46
D27: Electrical equipment	0.008	0.037	0.610	0.991	7,360.55
D28: Machinery and equipment, nec	0.006	0.035	0.582	0.957	22,341.53
D29: Motor vehicles, trailers and semi-trailers	0.008	0.029	0.610	0.888	9,097.63
D30: Other transport equipment	0.006	0.030	0.582	0.894	**
D31T33: Other manufacturing	0.013	0.033	0.679	0.933	22,613.86
D35T39: Electricity, gas, water supply, sewerage, waste	0.424	0.160	1.194	1.122	37,651.71
D41T43: Construction	0.015	0.040	0.717	1.002	147,338.37
D45T47: Wholesale and retail trade; repair of vehicles	0.008	0.022	0.615	0.793	143,199.42
D49T53: Transportation and storage	0.128	0.081	1.046	1.044	40,620.32
D55T56: Accommodation and food services	0.004	0.030	0.561	0.890	36,773.20
D58T60: Publishing, audiovisual and broadcasting	0.001	0.021	0.509	0.774	***
D61: Telecommunications	0.000	0.013	0.502	0.674	3,768.99
D62T63: IT and other information services	0.001	0.011	0.511	0.647	13,026.21
D64T66: Financial and insurance activities	0.001	0.008	0.510	0.604	9,211.84
D68: Real estate activities	0.000	0.005	0.503	0.560	114,629.78
D69T82: Other business sector services	0.003	0.015	0.536	0.700	57,118.96
D84: Public admin. and defence; comp. social security	0.003	0.011	0.545	0.645	****
D85: Education	0.000	0.007	0.503	0.589	23,134.71
D86T88: Human health and social work	0.002	0.015	0.530	0.700	*****
D90T96: Arts, entertainment, recreation and other	0.003	0.019	0.544	0.757	
Total loans					885,452.89
weighted average for economic activities	0.035	0.038	1.000	1.000	
weighted average of loans	0.067	0.050			

* loan data on D16 is included in D31T33 "other manufacturing", ** loan data on D30 "other transport equipment" is included in D29 "motor vehicles", *** loan data on D57T60 "Publishing..." is included in D62T63 "Telecommunications...", **** loan data on D84 "Public administration..." is excluded from data., ***** loan data refers to all sectors D85T96. Source: Bank of Italy for loans, Molocchi (2019) for external costs estimates.

costs related to the *value of production* (as known, the values of a sector’s value added, production and demand are totally different, for example the value added doesn’t include the value of intermediate goods used in the production of a certain sector).

⁹ ERWAs have been obtained as differences from the national weighted average and applying a smoothing factor to keep the coefficient into the 0.5–1.5 range. Maximum value of the ERWA coefficient (1.5) corresponds to 1 euro of specific external costs. Minimum value of the index (0.5) corresponds to zero (or negative) specific external costs.

These data show many interesting points.

First of all, most economic sectors are light green (i.e. external costs are lower than the economy-wide average): 24 with DECSA ERWAs and 19 with ECFiD ERWAs on a total of 33 sectors (we put in yellow the sectors that are brown in the ECFiD measurement but light green in the DECSA one). Light green sectors represent almost 80% of total corporate loans with the DECSA measurement and 55% with the ECFiD one.

Even if with ECFiD ERWAs more sectors appear to be brown due to the supply chain contribution to each sector's external costs (13 sectors against 9 in the DECSA approach), their ERWA values are in most cases slightly higher than 1 and for only three sectors with values beyond 10% (18% agriculture, 17% mineral products, 12% electricity production). In the DECSA approach, that is more focused on the direct responsibility of each sector, some sectors show much higher discouraging factors (oil refining 1.468, mineral products 1.211, electricity production 1.194).

All in all, the high proportion of corporate loans provided to light green sectors in the DECSA approach and the overall low ERWA values of the brown sectors in the ECFiD approach (with the exception of three sectors) confirm what we concluded in EMM: the application of ERWAs would not be disruptive both for banking and for the economic system.

4. The EU taxonomy approach for environmental sustainability

The full implementation of the EC Action Plan *Financing Sustainable Growth* (EC, 2018b)¹⁰ is going to deeply innovate European policies for environmentally sustainable finance, starting from financial products such as mutual funds and bonds, but affecting credit activity as well. In summary, there are three new parallel European regulatory streams to be taken into account -the first of which is the most important- to build up a policy proposal concerning environment-related financial risk reduction tools in credit activity:

- 1) the *Taxonomy* stream, that is mainly represented by the Commission legislative proposal for a Regulation to establish a framework to facilitate sustainable investment (EC, 2018c) and the two Technical Expert Group (TEG) reports on taxonomy published on June 2019 (TEG 2019a; TEG 2019b)¹¹;
- 2) the *Non-financial information* stream, related to Directive 2014/95/EU,¹² particularly the new Supplement on climate related information of Guidelines on non-financial reporting published in GUCE on 20th June 2019 (EC, 2019);
- 3) the *Financial Product disclosure* stream, represented by the EU Regulation on *Disclosure relating to Sustainability risks and Sustainable Investments*, that has been approved by the Trilogue in May 2019 (the official text is under release in the Official EU Gazette).

This section is devoted to describe the essential features of these regulatory developments to analyse their main implications for lending and financing in general.

¹⁰ The Commission Action Plan lays down ten priority actions in different areas of green and sustainable finance. The main initiatives are the 24 May 2018 package of three EC proposals for new regulations of the EU Parliament and the Council and the June 2019 package, with the publication of the new Commission Guidelines on the disclosure of climate related information (EC, 2019), the TEG's reports on taxonomy (TEG 2019a and TEG 2019b), on green bonds (2019c) and carbon benchmarks (2019d).

¹¹ Given that the approval process of taxonomy regulation is still ongoing in the EU Parliament and Council, we made reference here to the original legislative proposal by the Commission (COM (2018) 353 final). As to the work by the Technical Expert Group (TEG) supporting the Commission on different issues of the Action Plan for the related technical issues, particularly on taxonomy, reference is made to the "Taxonomy Technical Report" (TEG, 2019a) and the TEG Supplementary report "Using the taxonomy" (TEG, 2019b) published on 18 June 2019.

¹² [Directive 2014/95/EU](#) lays down the rules on disclosure of non-financial and diversity information by large companies. This directive amends the accounting directive 2013/34/EU. Companies are required to include non-financial statements in their annual reports from 2018 onwards. The Directive only applies to large public-interest companies with more than 500 employees (listed companies, banks, insurance companies and other companies designated by national authorities as public-interest entities). It covers approximately 6,000 large companies and groups across the EU.

4.1 The Taxonomy Stream

The taxonomy regulation proposal (EC, 2018c) states that an economic activity can be considered environmentally sustainable if it complies with all of the following criteria:

- (a) the economic activity *contributes substantially* to one or more of the following environmental objectives:
 - 1) climate change mitigation;
 - 2) climate change adaptation;
 - 3) sustainable use and protection of water and marine resources;
 - 4) transition to a circular economy, waste prevention and recycling;
 - 5) pollution prevention control;
 - 6) protection of healthy ecosystems;
- (b) the economic activity *does not significantly harm* to any of the above-mentioned environmental objectives;
- (c) the economic activity is carried out in compliance with defined *minimum social safeguards* laid;
- (d) the economic activity complies with the *technical screening criteria* established by the Commission through a series of delegated acts, the first of which will be on economic activities complying with climate mitigation and adaptation (to be adopted within 31/12/2019), while others will follow on circular economy and pollution prevention (within 1/7/2021) and on water and ecosystems (within 1/7/2022).

In the Commission plan, the taxonomy will be developed gradually. The TEG reports on taxonomy (TEG 2019a and 2019b) covers activities that make a substantial contribution to climate change mitigation and adaptation. More activities, related to other objectives, will be added in the next years.

Since the taxonomy applies to economic activities, in order to develop its technical proposal the TEG adopted the NACE industrial classification system as a reference to screen subsectors within which environmentally sustainable activities could be identified. NACE is the official account system for economic activities under EU Law;¹³ it covers every economic activity and it is also used for credit reporting. TEG report on taxonomy identifies three types of activities (see figure 1) that could potentially provide a substantial contribution to climate change mitigation (provided that the concerned activity can also fulfil the technical screening criteria, such as an energy efficiency standard or an emission indicator's threshold):

- (type 1) *activities that are already low carbon* (activities with a high mitigation potential such as zero emissions transport services, near to zero carbon electricity generation with an emission intensity lower than 50g CO₂/kWh) or even negative emissions (activities that are net carbon sinks such as afforestation);
- (type 2) *activities that contribute to a transition* to a zero net emissions economy in 2050 but are not currently operating at that level (even if they are not already low carbon, these activities achieve significant emissions reductions by perform better than the industry average, such as electricity generation with an emission intensity lower than 100g CO₂/kWh);
- (type 3) *activities that enable the type 1 and 2 activities*, allowing substantial emissions reductions (production of a low emission plant or vehicle, installation services related to a high efficiency boiler, mining of a particular material that is critical for the development of a low carbon activity, real estate services related to nearly zero buildings).

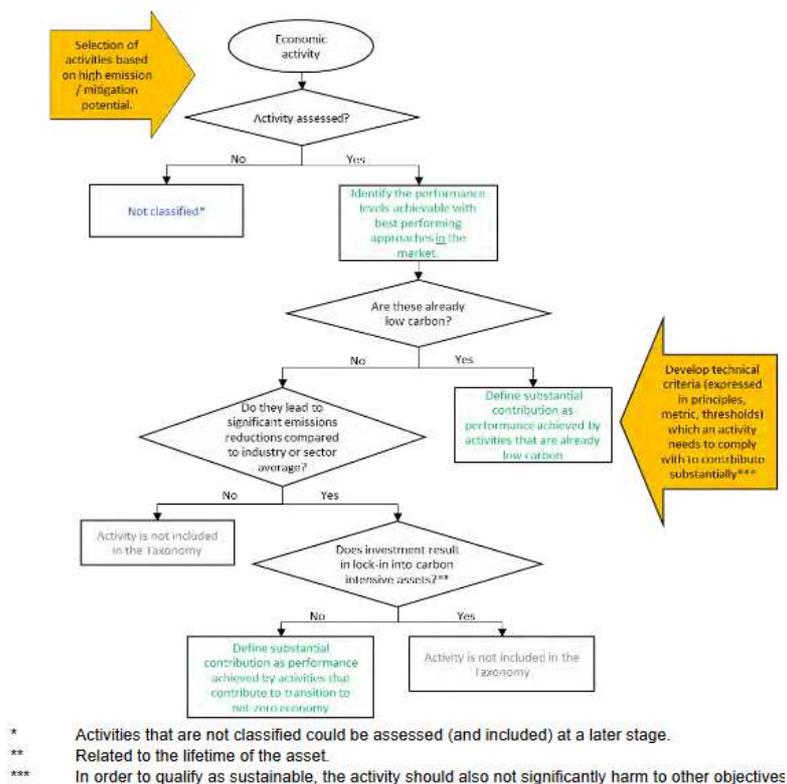
For a better clarification of the notions of *substantial contribution* that has been applied for the screening of activities included in the taxonomy for mitigation, figure 1 shows the decision tree adopted by TEG. As it seems, type 1-3 activities respond to different notions of “substantial

¹³ NACE (Nomenclature générale des Activités Economiques dans les Communautés Européennes) refers to the classification of economic activities established within the EU. The last revision (rev. 2) is defined in Regulation n. 1893/2006 of the European Parliament and the Council of 20 December 2006.

contribution” to a certain environmental target. While type 1 activities must comply with technical screening criteria representing very low carbon levels, *type 2 and 3 do not assure by themselves low emission levels* but are included in the taxonomy for different reasons: type 2 activities can contribute to the transition to a low carbon economy through the regular revision and updating of the technical screening criteria to the best available technologies, while type 3 activities enable other sectors of economic activity or final consumers to use low emission or high efficiency goods (nearly zero emission buildings, electric cars, triple glazing of windows, etc.) even if their direct environmental performance could be further improved.

Annex 1 provides the complete list of NACE sectors and activities included by the taxonomy on climate change mitigation.¹⁴ It is worth mentioning that the list is not a sufficient condition for green: the part F of the Taxonomy document (TEG, 2019a) provides the details of the technical screening criteria that must be fulfilled by each activity in the list, including the criteria related to the *do not harm principle* to other environmental objectives.

Figure 1: Decision tree for the inclusion of economic activities in the EU Taxonomy - climate mitigation



Source: TEG (2019a), figure 9.

4.2 The Non-financial Information Stream

¹⁴ Most of activities included in the taxonomy list of Annex 1 are subsectors of NACE classification system. Some exceptions to the rule can be found, such as “energy and resource efficiency in manufacturing” classified under the “Manufacturing” sector (they are indeed professional services of the tertiary); “light passenger cars and commercial vehicles” classified under the NACE tertiary sector “Transportation and storage” (they are indeed final products and not economic activities, excluded as such from NACE); “infrastructure for low carbon transport” are also classified under NACE tertiary sector “Transportation and storage” even if they are not economic activities, but the final product obtained from them; on the contrary “manufacturing of low carbon transport infrastructure” is an economic activity belonging to the NACE “Construction” sector but is included in the taxonomy under “Manufacturing”.

The new Commission Guidelines on disclosure of climate related information (EC, 2019) introduced some provisions specifically related to the Taxonomy, creating a link with the reporting obligation of large listed companies, banks and insurances.¹⁵

The first innovation concerns the fact that the information conveyed by the companies obliged to the Non-Financial Declaration (NFD) should not be limited to climate risks but should be extended to opportunities as well, with the aim to improve the company reporting on those economic activities that provide a substantial contribution to climate mitigation or adaptation (the taxonomy regulatory stream has indeed the purpose of identifying and classifying such activities). To help this kind of reporting the Guidelines section on key performance indicators (KPI) suggests the inclusion in the NFD of KPI related to the taxonomy, such as the percentage of the annual turnover from products or services associated with activities that meet the criteria for mitigation and adaptation established by the Taxonomy Regulation or the ratio of green bonds on the total of outstanding bonds.

The additional section of the Guidelines, devoted to banks and insurance companies (Annex 1), recommends specific indicators for the following activities (only some examples are provided in brackets):

- Equity portfolio management (e.g. weighted average carbon intensity of each portfolio).
- Lending and investment (e.g. volume of financial assets funding sustainable economic activities contributing substantially to climate mitigation and/or adaptation according to the EU taxonomy).
- Insurance underwriting (e.g. number and value of climate-related underwriting products offered).
- Asset management (e.g. breakdown of assets under management by business sector across asset classes).

The Guidelines represent a first attempt by the Commission to align the Non-financial information Directive to green finance. Once the Taxonomy Regulation will be approved, the Commission will be in a better position to update the Non-Financial Directive to optimize the relations between the two disciplines.

4.3 Disclosure on Financial Products

The Regulation proposal on environmental taxonomy was intended to be aligned with the requirements of the “Proposal for a regulation on disclosure relating to sustainability risks and sustainable investments” of 24 May 2018¹⁶, that has been approved by the Trilogue in May 2019. Under this regulation, financial market participants¹⁷ offering a “green” financial product must disclose which are these objectives and the methodologies used to assess, measure and monitor progress against the sustainability objectives, as well as the results of the sustainability related

¹⁵ The Directive 2014/95/EU applies to large listed firms included banks and insurance companies. The Commission Guidelines aim to support companies to comply with the Directive obligations. They have a non-binding, voluntary nature. It is worth mentioning that Guidelines specify that financial companies should consider the impacts on the climate of the activities that they support or facilitate, a recommendation that is not easy to implement given that it requires a system for detecting information that is not fully controlled by such companies. For this reason, the Annex 1 of the Guidelines provides additional guidance for banks and insurance companies.

¹⁶ Proposal for a regulation on disclosures relating to sustainable investments and sustainability risks and amending Directive (EU) 2016/2341 COM (2018) 354 final. 2018/0179 (COD).

¹⁷ The definition of “financial market participants” and of “financial products” is provided respectively, by Article 2 (a) and Article 2 (j) of the aforementioned “Proposal” amending Directive (EU) 2016/2341. Examples of ‘financial market participant’ are: investment firms, alternative investment fund managers, a UCITS management company. Examples of financial products are: alternative investment funds, pension funds, UCITS.

impact of the financial product. Investors offering products aligned with the environmental taxonomy must disclose how and to what extent the product is aligned with the taxonomy.¹⁸

To comply with the Regulation, suppliers of financial products are thus expected to:

- identify the activities, conducted by the company or issuer, covered by the financial product;
- for each activity type, assess whether the company or issuer meets the relevant technical criteria for a substantial contribution to at least one of the six environmental objectives;
- verify that the “do not significant harm” criteria are being met;
- conduct due diligence to avoid violations to the social minimum safeguards required by the taxonomy regulation;
- calculate the proportion of the company or turnover related to the green activities and assume such proportion as the percentage of the asset complying with the taxonomy;
- finally, on the basis of the portfolio composition, calculate the share of the financial product that is taxonomy-eligible.

4.4 Implications for Lending Activities

It is interesting to observe that even if the taxonomy has been conceived to be applied to green financial products (“green bonds”), it can be easily applied to credit activity, especially in corporate banking but also in some types of retail banking provided that the lender can prove a link between the loan and the green activities of the beneficiary on the basis of the EC Guidelines on climate related information. Moreover, there are also firms whose activities fully or partially comply with the taxonomy: the general lending to them (current accounts and other non-destined types of lending) provided to such firms could be also considered “green”. In the case of financial investment in equities, both the TEG (2019b) and the EC Guidelines on climate related information recommend the *turnover* criteria to estimate the percentage of economic activities of the listed firm that are taxonomy compliant: the taxonomy method could be considered for general lending, as well, given that the company undertakes an analysis of its economic activities to find out the percentage that is compliant with the taxonomy rules.

Table 2: uses and users of the taxonomy

Users	Compliance with disclosure obligations	Optional additional uses
Asset Management	UCITS, Alternative Investment Funds, Individual Wealth Management	
Insurance	Insurance-based investment products (IBIP)	- Insurance
Corporate & Investment Banking	- Securitisation funds, ABS - Venture capital and private equity funds - Individual Wealth Management - Indices funds	- Securitisation - Venture capital and private equity - Project finance and corporate financing
Retail banking		- Mortgages - Commercial building loans - Car loans - Home equity loans

Source: TEG (2019b), page 9.

Other comments on the taxonomy and other related regulatory streams can be summarised as follows:

- Even if the disclosure obligation does not fall directly on listed companies or on companies issuing bonds (it falls on financial market participants offering green products), the former are fully involved in the process of data collection through the Non-financial information

¹⁸ The Disclosure Regulation final text allows issuers to apply also other methods (other than the taxonomy) to comply with disclosure obligations, provided that the alternative methodologies are explained in the firms declarations.

provisions. Data on taxonomy compliant activities at company level could be potentially estimated by data providers through a mix of methodologies. However, listed companies have good reasons to cooperate with investors and data providers in collecting data in line with the taxonomy: fulfilling the taxonomy standards will help these companies to raise funds for their (green) activities. Given that the taxonomy is based on six environmental targets, it is clear that further environmental Guidelines and a revision of Directive 2014/95/EU are needed.

- Even if the environmental taxonomy has been developed by TEG starting from *economic activities*,¹⁹ the way the taxonomy is being developed (“mitigation activities” in many cases related to energy standards in the use phase of a product, “enabling activities” related to energy efficient or low carbon products) allows the classification of *green products* as well, such as low carbon cars or high efficient heating systems, for both companies and consumers. This means that many consumer activities (non-NACE activities), outside of the direct taxonomy scope, are in reality included through the specific screening criteria established for economic activities.
- Both the TEG (2019b) and the EC Guidelines on climate related information recommend an environmental life cycle approach or, at least, an approach that considers the whole supply chain including upstream and downstream activities that are not directly under the company control. This means a preference for the second type of ERWAs we proposed (ECFiD), that include the external costs related to emissions of all sectors that contribute to the production of a specific sector.
- The EU taxonomy has been designed to identify green activities only, excluding from its scope the classification (and the measurement of the environmental performance) of non-green activities: for example those activities that provide a slight contribution - that is not *substantial* - to at least one environmental objective (“light green” activities), or those that undermine any environmental objective (brown activities) are excluded from the taxonomy.²⁰ Overall, the EU taxonomy is a first step for measuring and classifying environmentally sustainable activities, but to reach full consistency with target 2.1.c of the Paris Agreement (“to make finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development”) it needs to be complemented with other approaches, in order to involve and push also non-green activities and products towards the needed transition.

5. How to extend ERWAs in the context of the EU taxonomy

As we said, to make ERWAs a business model neutral tool, every part of banks’ balance sheet should be weighted using them. This means, basically, loans and securities. We describe these assets using Italy as an example. As for loans, we can sum up their destination in the following table.

Table 3: composition of lending by counterparty in Italy

General government	264,382	14.8%
Financial companies (excluding Monetary Financial Institutions)	220,537	12.4%
Non-financial companies and producer households	758,915	42.6%
Consumer households	537,704	30.2%

Source: Bank of Italy, 2019a, pp.11 and following. Data in millions of Euro; end of 2018.

¹⁹ The environmental taxonomy has been developed by TEG starting from *economic activities*, to make it easier to connect activities with appropriate financial indicators (turnover in case of holdings, eligible expenditures in case of green bonds) and the latter with the related assets.

²⁰ According to TEG (2019a), the expected coverage of the taxonomy is about 5% of the overall value added of economic activities.

Let's discuss the options for the different recipients (Figure 2 summarizes the various cases). In EMM we excluded loans to government from the ERWA. We will see how to include them in some cases later on. As for the other recipients (firms and households) that make the vast majority of loans, we first describe the main types of loans and then we propose how to treat them into the ERWAs framework.

In the case of households, we can divide loans into three categories. The bulk is made by house mortgages (almost €345 billion). The second component is made by loans for cars, durable goods, etc. (so called finalized loans) whose main part is given by car loans (about €18 billion). The last part is made by generic consumer lending (personal loans, loans secured by pledge of salary, credit cards, etc.) that amount to around €90 billion. The first two categories can derive their weighting from the environmental indicator or energy consumption class of the product they are funding (for instance, the energy consumption class related to a building or the approved CO₂/km emissions of a car). Therefore, to treat these lending categories we propose to use *product ERWAs* consistent with the technical screening criteria of the EU taxonomy.²¹ Ordinary consumer lending is not currently linked to any particular good or service, neither entails a particular financial risk connected to environmental issues. Therefore, we think it is premature to include it in ERWAs application, until new innovative forms of consumer lending will make it possible to establish a link with a measure of the environmental performance related to single transactions. The ERWA logic will incentivize market operators in this direction.

In the case of corporate lending we can also distinguish between general corporate loans and loans that have a specific destination (for instance, leasing). The data confirm that the latter is the bulk of the total.

Table 4: composition of corporate lending in Italy

current accounts	93,277
mortgage loans	358,163
factoring	16,880
financial leasing	32,365

Source: Bank of Italy, 2019a, pp. 20 and following. Data in millions of Euro; end of 2018. Counterparty: non-financial companies and produces households.

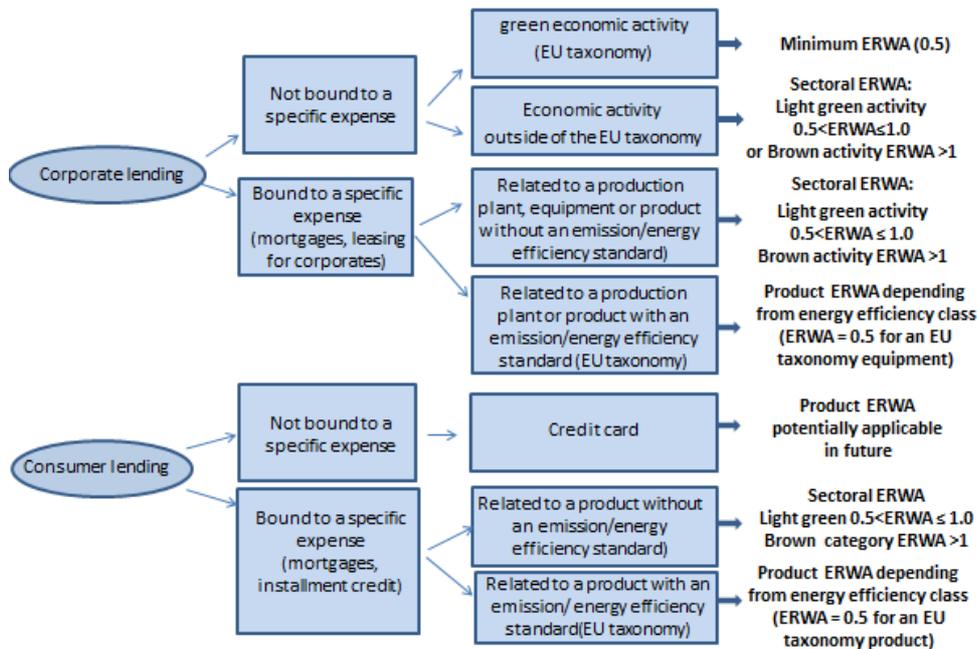
While current accounts cannot be easily linked to a specific activity of the firm, the other types of loans are more or less connected to a product or project. In the first case, when the bank is giving a general corporate loan, we suggest to apply the sectoral ECFiD ERWAs related to the sector of activity of the recipient firm,²² unless the latter can demonstrate that its activities are compliant with the EU taxonomy. For example, if the borrowing firm can demonstrate that 30% of its revenues is related to activities that are aligned with the taxonomy, we suggest to apply the minimum ERWA value proportionally i.e. the of 0.5 for the 30% of the lending and the sectoral ERWA, let's say 0.9, for the remaining 70% of its activities. Our proposal for general corporate loans is to apply the weighted average (0.78 in the example) of ERWA values related to both (taxonomy) compliant and non-compliant activities; in this way *all the activities* of a certain firm would be covered.

²¹ As we noted, the screening criteria of the taxonomy are aimed at selecting green activities only, excluding activities whose contribution to an environmental objective is considered not substantial or that are counterproductive to an environmental objective.

²² Between the two approaches suggested, ERWAs based on the embodied external cost in final demand (ECFiD) are recommended in this case, since they take into account a life cycle approach by including in the external cost calculation the contribution of the whole supply chain of each sector.

For loans with a specific destination, we suggest to use *product ERWAs* consistent with the technical screening criteria of the product categories of the EU taxonomy. In particular, we suggest to apply the minimum ERWA value of 0.5 for loans aimed at investing in a product that is compliant with the technical screening threshold of the EU taxonomy, and ERWA values in the range between 0.5 and 1.5 (depending from the energy efficiency class or the value of the emission intensity indicator of the product) if the product does not satisfy the threshold of the taxonomy. Section 5 will provide many examples of this approach.

Figure 2: Sectoral ERWAs and Product ERWAs: integration with the EU taxonomy framework



From the point of view of technology adoption, literature suggest that a more specific policy tool (i.e. the product ERWA) is more useful when new technologies are available and ready to substitute older and less efficient technologies; if the choice is left to the market alone it will tend to stick to the older and more known technology (Polzin *et al.*, 2019). Therefore, broadly speaking, we can conclude that product ERWA can be a more precise and stronger incentive to the transition than sectoral ERWA and when it is possible it is better to use the former.

We give an example to explain how the two types of ERWA can be applied. If a construction company approaches a bank for a loan, when assessing the capital absorption of the loan, the bank has two options: a) to weight the loan for the average environmental risk of the general activities of the company by using the “construction” sector *ECFiD ERWA* or, b) if the loan is related to something green, like a renovation project of an existing building, it can weigh the loan using the *product ERWA* related to the targeted energy efficiency class of the renovation project (the better ERWA, that is 0.5, can be used only if the renovation projects aims to reach at least the B class in terms of energy performance of the building). Of course, the latter option can be given to the bank only if it can prove that the project does comply with the taxonomy technical screening criteria for the renovation of buildings. As for bonds, in Table 5 we synthetize their weight on the Italian banks’ balance sheet:

Table 5: loans and bonds in Italian banks

loans	1,640,263	44.7%
MFI bonds	56,699	1.5%
government bonds	375,573	10.2%
corporate bonds	235,331	6.4%

Source; Bank of Italy, 2019b, p. 61. Data at the end of 2018. First column: data in millions of euro; second column as a percentage of total assets.

As it is well known, corporate bonds are a minor part of Italian banks' assets. Anyway as we are developing a EU-wide tool, ERWAs should be used for these assets too. We propose to them irrespectively for their allocation into the different regulatory portfolios (under the prevailing accounting and prudential standards) using the same framework we described for loans. Securities can be used to finance either the general activity of a firm or a specific project. In the first case, sectoral ERWAs can be applied to them, in the second one a mix of sectoral and product ERWAs can be applied, depending from the availability of energy efficiency standards of equipment and products to be purchased. This can also be extended to asset backed securities (ABS) that, once again, can be divided between sectoral ABS (that can take their sectoral ERWA) and specific investment ABS (that can take their mix of sectoral and product ERWAs).

With the combined utilization of sectoral and product ERWAs, the proposed policy tool is basically neutral vis à vis the composition of the assets of the banks: the weighting will depend from the CO₂ emissions (simpler) or the external costs (more articulated but complete) related to the activity that has been funded, not from the way it is funded.

The last loan recipients we mention are the financial companies. Given that they embed a very limited quantity of direct external costs, in EMM we excluded them from the application. However, sectoral ERWAs can be applied to them too. Another much more complex option is to apply the weighted average of ERWAs related to the lending portfolio of the recipient institutions (including banks), by following the same approach shown in Table 1 to calculate the external cost footprint of lending in Italy. In this scenario, each bank should assess its lending footprint. A step-by-step approach, starting with the average CO₂ emissions related to the sector, as suggested in EMM, would be recommended. A growing list of banks are internally experimenting this approach in Italy.²³ Once extended to the entire sector, banks' footprint could be adopted for ERWAs in lending between banks.

6. How to create product ERWAs: the case of energy efficient mortgages

In terms of dimension, the most important application of product ERWA is by far to mortgage loans. In fact, "The volume of outstanding mortgage loans in the EU amounted to EUR 7 trillion at the end of 2016, representing 30% of total assets in the EU banking sector... and equalling 47% of EU GDP" (EeMAP, 2017a) and "Buildings account for 40 per cent of energy use in the European Union" (EeMAP, 2017b). EeMAP - Energy efficient Mortgages Action Plan²⁴ is the main European market-led initiative aimed to develop a standard for energy efficient mortgages, promoted by a Consortium guided by the EMF - European Mortgage Federation and the ECBC -

²³ For an introduction, see the documentation of the Bank of Italy workshop held the 3th of July 2019 (<https://www.bancaditalia.it/media/notizia/disponibili-gli-atti-del-convegno-sviluppo-sostenibile-finanza-e-rischi-climatici/>).

²⁴ The EeMAP Initiative aims to create a standardised "energy efficient mortgage", according to which building owners are incentivised to improve the energy efficiency of their buildings or acquire an already energy efficient property by way of preferential financing conditions linked to the mortgage (see the website: www.energyefficientmortgages.eu).

European Covered Bond Council. The general structure of this initiative is aligned to the design of ERWA inasmuch as it entails the idea that green mortgages are less risky for lenders: “One of the key premises of the EeMAP Initiative is that energy efficiency has a positive impact on credit risk” (EeMAP, 2017a). For now, scientific literature on the issue is sparse and almost all on US market, anyway studies “find evidence of a significant reduction in default risk associated with energy efficiency. This effect is larger for houses that are more energy efficient” (EeMAP, 2019). They are less risky also because green buildings have a higher value when they are sold, therefore they are a better collateral for the banks, *ceteris paribus*. The EU taxonomy is expected to deeply innovate current financial practices in the construction and real estate sector by introducing a regulatory framework for energy efficient activities related to buildings. Part F of the TEG report on taxonomy (TEG, 2019a) provides a thorough taxonomy cards for buildings.²⁵

- 1) Construction of new buildings and renovation of existing buildings are two categories of economic activity that are usually performed by construction companies. The threshold criteria are different for the two cases. For new buildings the proposed threshold is compliance with energy performance standards set for Net Zero Emission Building (NZEB) in national legislation with an EPC rating at least class B (EPC classes go from the least efficient G to the most efficient A, that is divided in four classes A1-A4).²⁶
- 2) For renovation of existing building the TEG proposes two optional thresholds: a) compliance with the energy performance standards set in national regulations for major renovations; b) achievement of a minimum 30% primary energy saving in comparison to the baseline performance before the renovation.
- 3) Individual renovation measures (such as installation of efficient lighting, addition of insulation to the existing envelope components, installation of solar hot water panels or photovoltaic systems) whose specific energy efficiency standards are laid down in national legislation transposing the Energy Performance of Buildings Directive (EPBD), are economic activities offered by specialized construction companies and installation service providers belonging to the NACE sector “professional, scientific and technical activities”. It’s worth mentioning that also households are involved in these measures and they could need credit to afford such interventions.
- 4) The most important taxonomy category for the mortgage market is the fourth one: *acquisition of buildings*. The TEG sheet (26.5) describe this activity group as related to NACE Code “Real estate activities”, but it’s obvious that the main source of credit demand related to building acquisition is made by the wide set of household buyers. The TEG proposal distinguishes three types of acquisition: without any renovation, with major or minor renovation. In the first case, the threshold is given by EPC class B (or above), in order to boost the market (and value) of very efficient buildings. The other two types are very important for achieving decarbonization in the existing building sector, since they link the purchase of the building with the commitment for the new property to carry out a deep energy renovation within three years of purchase, in order to a) reach at least a 30% of primary energy saving as compared to the baseline before renovation or b) to obtain an EPC high efficiency rating of at least class B.

To create product ERWA values under a framework that is consistent with the taxonomy, the following principles should be applied:

²⁵ Construction of new buildings (26.2), Renovation of existing buildings (26.3), Individual renovation measures (26.4), Acquisition of buildings (26.5).

²⁶ Many houses do not have an EPC, since EPC is required only when selling or renting a property, and its validity is limited to 10 years. In 2014 no EU country had a building stock with more than 35% of EPC and only three countries had more than 10% (EeMAP, 2017b PI), although these percentages increase gradually every year.

- if the loan (mortgage or other loan type that is clearly linked with eligible CapEx or OpEx of the borrower) is related to a building activity that fulfils the taxonomy threshold, the assigned ERWA is the minimum value (0.5);
- if the loan is related to a building activity that does not fulfil a taxonomy threshold that is mandatory by legislation (new construction case), the ERWA value is 1.1;
- if the loan is related to a building activity with EPC from class C to G, ERWA values from 0.7 to 1.1 are assigned to the increasingly higher energy consumption classes.

Therefore, in the case of *building acquisition* activities, the mortgage related to the purchasing of a G class apartment without planning any energy renovation intervention, would be a discouraging ERWA value of 1.1. If the buyer plans a minor renovation intervention that enables to reach a 20% energy saving (instead to the more ambitious 30% compliant with the taxonomy), an ERWA of 0.7 would still provide a premium to the related mortgage. Table 5 resumes our product ERWA proposal for the sector based on the taxonomy.

Research shows that green mortgages could be very appealing for consumers (EeMAP, 2018) and that bonds created to fund these mortgages would be also appealing for investors (EeMAP, 2017a). The taxonomy thresholds proposed by TEG are ambitious and exclude the possibility of a premium in capital requirements for lower ambition energy efficiency improvements. Our proposal of product ERWAs for the sector provides a differentiated premium according to the energy efficiency class.

For sure, some problems related to the standard and its measurement need to be addressed. First of all, the TEG proposes to compare energy efficiency of buildings using the EPC (Energy Performance Certificate) introduced with the first EPBD in 2002 (Directive 2002/91/EC). Unfortunately, there is a lack of consistency between EPCs in different Member States due to different national transposition of the Directive (EeMAP, 2017b). An additional issue is compliance with EPBD. According to a study by ICF International, compliance rates reported for EPCs required for new constructions and sales in 2014 range from 70% to 100% with an average of 88% and were generally higher than those reported for rentals, which averaged 73% (ICF International, 2015). These data suggest that EPC production in the European building sales market is generally well monitored and controlled, but improvements are needed in some countries.²⁷ To make effective policies through capital requirements on green mortgages, the EU must continue to work to improve comparability of data and compliance to building regulations.

We detailed our proposal for loans related to houses because this is by far the most important recipient in terms of credit. Annex 2 provides two additional examples on how to create product ERWAs consistent with the taxonomy approach, respectively for passenger cars and commercial vehicles and for heavy duty vehicles. These categories are mostly related to leasing and vehicle credit markets.

²⁷ See sec. 4.2.1 of ICF International, 2015. The report, prepared for the Directorate-General for Energy of the EC, aims at analysing on-the-ground compliance with the current national regulatory frameworks across the EU Member States.

Table 5: how to apply ERWA to the construction sector under the EU taxonomy²⁸

Cases	New building construction	Major renovation of existing building	Minor renovation of existing building	Individual energy renovation measure	Acquisitions of buildings - without energy renovation	Acquisitions of buildings -with minor renovation	Acquisitions of buildings -with major renovation
Taxonomy reference	26.2	26.3	26.3	26.4	26.5	26.5	26.5
Borrower	Construction companies	Construction companies	Construction companies, households	Construction companies, installation services, households	Real estate agencies, households	Construction companies, real estate agencies, households	Construction companies, real estate agencies, households
ERWA = 0.5 (EU taxonomy compliant)	Compliant with energy performance standards set for NZEB in national legislation transposing EPBD and EPC ratings classes A1-A4, B (equivalent to the level of performance of the top 15% of the national building stock)	Compliant with the energy performance standards set in national legislation transposing EPBD	At least 30% primary energy saving in comparison to baseline before the renovation (or compliance with the energy performance standards set in national regulations for major renovation)	Compliant with energy performance standards set for individual components and systems in national legislation transposing EPBD (examples for Italy: electric heat pumps COP _{th} > 3; Heat generator gas fuel $\mu > 0.95$)	EPC ratings classes A1-A4, B	EPC ratings classes A1-A4, B or at least 30% primary energy saving in comparison to baseline before the renovation	Compliant with energy performance standards set in national legislation transposing EPBD (equivalent to the level of performance of the top 15% of the national building stock)
ERWA = 0.7	EPC class C or at least 20% energy saving	n.a.	EPC class C or at least 20% energy saving	n.a.	EPC class C	EPC class C or at least 20% energy saving	n.a.
ERWA = 0.8	EPC class D or at least 15% energy saving	n.a.	EPC class D or at least 15% energy saving	n.a.	EPC class D	EPC class D or at least 10% energy saving	n.a.
ERWA = 0.9	EPC class E or at least 10% energy saving	n.a.	EPC class E or at least 10% energy saving	n.a.	EPC class E	EPC class E	n.a.
ERWA = 1.0	EPC class F	n.a.	EPC class F	n.a.	EPC class F	EPC class F	n.a.
ERWA = 1.1	EPC class G	Non-compliant with energy performance standards for major renovations	EPC class G	Non-compliance with energy performance standards of national legislation transposing EPBD	EPC class G	EPC class G	Non-compliant with energy performance standards EPBD

²⁸ The table presents more than four columns since each sheet of the taxonomy proposes different thresholds in the different situations (acquisition with or without renovation, etc.).

6. Open issues and future research

The awareness of the need for a rapid transition towards a green economy is gaining traction. In order to achieve such a momentous goal, all the institutions and economic players must participate with an active role. The transition implies, *inter alia*, huge investment from public and private sources. This extraordinary funding need is at the root of the flourishing of sustainable finance, that will be one of the main driver in the finance and banking business in the coming years.

In EMM we proposed a tool to align the lending policies of the banks to the green transition goals. In these months a discussion on the links between prudential banking supervision and sustainable finance has thrived (Signorini, 2019) but as far as the operational side is concerned, the debate remains at a very early stage. In this paper we extended the results of EMM confirming that the tool can be tailored to be stable and not too penalizing for banks so that it can be used to help the transition without provoking a shock for the banking system. We proposed a way to extend ERWA to every part of banks' assets adding *product* ERWA to the *sectoral* ERWA and also to take into account the EU taxonomy that is still developing in these months but has already finalized many documents on how to treat projects and products as far as the transition is concerned.

The EU Institutions Action Plan for sustainable growth is an important cornerstone and entails ambitious goals that, however, risk to remain wishful thinking without a proper operational set-up. This is particularly true for the financial system. In its Communication of the last 8th of March, the EC rightly points out: "The financial system is being reformed to address the lessons of the financial crisis, and in this context it can be part of the solution towards a greener and more sustainable economy. Reorienting private capital to more sustainable investments requires a comprehensive shift in how the financial system works. This is necessary if the EU is to develop more sustainable economic growth, ensure the stability of the financial system, and foster more transparency and long-termism in the economy" (EC, 2018b). This is also what we suggested in EMM: using climate change to help the development of new banking business models.

It is also worth noting that the ERWAs logic is completely in line with the three specific goals posed for the financial sector in the Communication: "1. reorient capital flows towards sustainable investment in order to achieve sustainable and inclusive growth; 2. manage financial risks stemming from climate change, resource depletion, environmental degradation and social issues; and 3. foster transparency and long-termism in financial and economic activity" (ivi). More generally, the debate needs operational proposals to go forward successfully.

Besides the practical and political difficulties that have to be overcome to implement the ERWAs that we discussed in EMM (the main being the different energy mix of the different EU countries and hence different results of ERWAs application on a European scale), an important observation on the dynamic nature of ERWAs is necessary. ERWAs logic is to give banks a (positive/negative) "discount" on their capital requirements if they fund a (green/brown) sector, but, sectoral external costs can vary every year, as a function of emission trends. Do ERWAs can take into account this change? Sectoral ERWAs are built as a difference from an average. If a specific sector modifies its external costs roughly in line with the average dynamic, its ERWA does not change. If a sector is reducing its external costs more rapidly than on average, its ERWA will decrease, thus giving the right incentive to the financial system, that will be pushed to finance the more pro-active sectors in term of external costs reduction. These changes are sufficiently slow to allow banks' to adjust their activity (especially in terms of banking book composition) at a reasonable speed.

To give stability to banks' strategy, we propose to update ERWAs in coherence with the TEG (2019a) suggested periodical update of the technical screening criteria for the “mitigation activities” (and for enabling activities related to the former ones), this means every five years, starting from 2020, so to match last year with the deadline of the targets of the current EU energy and climate policy (2030).

Regulators should decide whether new ERWAs could be applied to the existing banking book. If a bank has funded five years ago a specific product that at the time had a certain ERWA, the original ERWA should be maintained for the existing loan, because the investment or product presumably maintains the same external costs. However, while this is true for product ERWA (since they are related by definition to an energy efficiency class or to a specific value of an emission intensity indicator), this could be not so true for sectoral ERWAs due to possible environmental improvements detected by the sector level average indicator. In the case of sectoral ERWAs, instead of a five-years validity period, it would make sense to allow the banks to use yearly updated ERWA values also to weight the old loans. We acknowledge that there are pros and cons in these choices. For instance, a more stable weighting of financial assets can help creating markets standards, especially for green bonds. On the other hands this lag does not help innovative investment in green technologies. Anyway these choices are part of the technical discussion on the best strategy to introduce ERWAs or similar tools in banking regulation. We wish we were already at that stage! As we noted, the operational debate is still in an initial phase. To really move things forward the newly elected EU institutions must take fully into their hands the issue of transition.

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Annex 1. Taxonomy: Selected macro-sectors and economic activities for climate change mitigation

NACE Macro-sector	Activities
Agriculture, forestry and fishing	<ul style="list-style-type: none"> Growing of perennial crops Growing of non-perennial crops Livestock production Afforestation Rehabilitation, Restoration Reforestation Existing forest management
Manufacturing Manufacturing (cont...)	<ul style="list-style-type: none"> Manufacture of Low carbon technologies Manufacture of Cement Manufacture of Aluminium Manufacture of Iron and Steel Manufacture of Hydrogen Manufacture of other inorganic basic chemicals Manufacture of other organic basic chemicals Manufacture of fertilizers and nitrogen compounds Manufacture of plastics in primary form
Electricity, gas, steam and air conditioning supply	<ul style="list-style-type: none"> Production of Electricity from Solar PV Production of Electricity from Concentrated Solar Power Production of Electricity from Wind Power Production of Electricity from Ocean Energy Production of Electricity from Hydropower Production of Electricity from Geothermal Production of Electricity from Gas Combustion Production of Electricity from Bioenergy Transmission and Distribution of Electricity Storage of Energy Manufacture of Biomass, Biogas or Biofuels Retrofit of Gas Transmission and Distribution Networks District Heating/Cooling Distribution Installation and operation of electric heat pumps Cogeneration of Heat/cool and Power from Concentrated Solar Power Cogeneration of Heat/Cool and Power from Geothermal Energy

	<p>Cogeneration of Heat/Cool and Power from Gas Combustion</p> <p>Cogeneration of Heat/Cool and Power from Bioenergy</p> <p>Production of Heat/Cool from Concentrated Solar Power</p> <p>Production of Heat/Cool from Geothermal</p> <p>Production of Heat/Cool from Gas Combustion</p> <p>Production of Heat/Cool from Bioenergy</p> <p>Production of Heat/Cool using Waste Heat</p>
Water, sewerage, waste and remediation	<p>Water collection, treatment and supply</p> <p>Centralized Wastewater treatment systems</p> <p>Anaerobic Digestion of Sewage sludge</p> <p>Separate collection and transport of non-hazardous waste in source-segregated fractions</p> <p>Anaerobic digestion of bio-waste</p> <p>Composting of bio-waste</p> <p>Material recovery from waste</p> <p>Landfill gas capture and energetic utilization</p> <p>Direct Air Capture of CO₂</p>
Water, sewerage, waste and remediation (cont...)	<p>Capture of Anthropogenic Emissions</p> <p>Transport of CO₂</p> <p>Permanent Sequestration of captured CO₂</p>
Transportation and storage	<p>Passenger rail transport (inter-urban)</p> <p>Freight rail transport</p> <p>Public transport</p> <p>Infrastructure for low carbon transport</p> <p>Passenger cars and commercial vehicles</p> <p>Freight transport services by road</p> <p>Interurban scheduled road transport</p> <p>Inland passenger water transport</p> <p>Inland freight water transport</p> <p>Construction of water projects</p>
ICT	<p>Data processing, hosting and related activities</p> <p>Data-driven solutions for GHG emissions reductions</p>
Construction and real estate activities	<p>Construction of new buildings</p> <p>Renovation of existing buildings</p> <p>Individual renovation measures, installation of renewables on-site and professional, scientific and technical activities</p> <p>Acquisition of buildings</p>

Source: TEG (2019b), pp 21-25.

Annex 2. How to create product ERWAs for road transport vehicles

Passenger cars and light commercial vehicles

In the case of passenger cars and light commercial vehicles (vans), the technical screening criteria of the taxonomy (zero tailpipe emission vehicles and -until 2025- vehicles with tailpipe emission intensity of max 50 gCO₂/km) is aligned with the new definitions of “zero emissions vehicles” and “clean vehicles” provided by the recently approved EU Legislation (Regulation 2019/631 setting CO₂ emission performance standards for new passenger cars and vans in the EU for the period after 2020, and the revised Clean Vehicle Directive²⁹ that aims to promote clean mobility solutions in public procurement tenders). For the aims of this paper, compliance of the borrower with the above-mentioned threshold is related to the minimum ERWA value of 0.5. Loans provided for the purchase of cars and vans slightly beyond 50 gCO₂/km could obtain a premium too, if consistent with the EU targets at 2030 to reduce CO₂ emissions of new cars. In fact, the new Regulation (EU) 2019/631 sets the following CO₂ emission performance targets, intended as average for new EU-fleets of passenger cars and light commercial vehicles (vans):

- Cars: 95 gCO₂/km in year 2020; 15% reduction as compared to 2021 from year 2025 on and 37.5% reduction as compared to 2021 from year 2030 on.
- Vans: 147 gCO₂/km in year 2020; 15% reduction as compared to 2021 from year 2025 on and 31% reduction as compared to 2021 from year 2030 on.

By calculating the above-mentioned reduction targets at 2025 starting from year 2020 (instead of 2021, in order to simplify), we obtain 80 gCO₂/km for cars and 125 gCO₂/km for vans.³⁰ ERWA values for cars and commercial vehicles with a carbon intensity *beyond* 50 g CO₂/km are put in table 6 by assigning the intermediate ERWA value of 1.0 to the 2025 targets in terms of carbon intensities.

Heavy Duty Vehicles (HDVs)

In the case of HDVs (freight transport services), TEG (2019a) proposes three optional technical screening criteria (see also table A):

- zero tailpipe emission vehicles;
- low-emission vehicles with specific emissions of less than 50% of the reference/average emission of all vehicles in the same subgroup;
- dedicated vehicles solely using biofuels and renewable fuels in line with Directive 2018/2001.

The first two criteria take into account the policy framework established by two new EU Regulations on HDVs CO₂ emissions:

- Regulation 2018/956 establishes how to monitor and communicate CO₂ emissions of new HDV by using both test bed and road test procedures, in order to obtain reliable and homogeneous data for specific groups and subgroups of HDV (allowing the calculation of reference CO₂ emissions for subgroups);
- The recently approved Regulation setting CO₂ emission performance levels for HDV³¹ adopts a general 15% CO₂ emission reduction target at 2025 and a 30% reduction target at 2030 as

²⁹ A trilogue agreement on the new text revising Directive 2009/33/EC, was reached on 11th February 2019. The Parliament adopted the text in the following April and the Council on 13th June 2019. The final act was signed on 20th June 2019. The revised Directive links the definition of clean vehicle to Directive 2014/94/EU on alternative fuels infrastructure, allows the counting of retrofitted vehicles towards procurement targets and extends the scope of the directive to public service contracts for parcel and mail delivery services and urban and household waste collection.

³⁰ By considering the differentiated targets adopted at 2020, 2025 and 2030 by Regulation 2019/631 it can be noticed that the common limit of 50 gCO₂/km (until 2025) adopted by the taxonomy both for cars and vans is particularly challenging for vans.

³¹ Also in this case a trilogue agreement on the new text revising Directive 2009/33/EC, was reached on 11th February 2019. The Parliament adopted the text in the following April and the Council on 13th June 2019. The final act was signed on 20th June 2019. The agreement sets a legally binding 30 % reduction target for the average fleet emissions of new trucks by 2030 as compared to 2019 levels. Zero and low-emission vehicles should reach a 2 % share of manufacturers sales by 2025. In 2022, the Commission will have to propose new post-2030 targets.

compared to 2019 reference levels for the new vehicles. The Regulation also establishes how to calculate specific targets for HDV manufactures consistently with the general target. With the aim of aligning the ERWA proposal for HDV, the new EU Regulation intermediate target of a 10% emission reduction at 2025 is assumed as a reference value for the neutral ERWA value of 1.0. Reductions between 50% (taxonomy) and 15% (2025 EU target) are allocated in the ERWA range 0.5-1.0, while new HDV achieving emissions reductions lower than 15% as compared to the CO₂ reference values at the subgroup level are given ERWA values > 1. We also recommend that after 2025 the ERWA values are updated to the HDV target at 2030 (30% emissions reduction).

Table 6: Product ERWAs - Road transport vehicles (passenger and freight)

ERWA	tailpipe emission intensity (car)	tailpipe emission intensity (LCV)	(until 2025) specific direct CO ₂ emissions of the reference CO ₂ emission of all vehicles in the same sub-group
0.5	<ul style="list-style-type: none"> Zero tailpipe emission vehicles; (Until 2025) Vehicles with tailpipe emission intensity of max 50 gCO₂/km 	<ul style="list-style-type: none"> Zero tailpipe emission vehicles; (Until 2025) Vehicles with tailpipe emission intensity of max 50 gCO₂/km 	<ul style="list-style-type: none"> Zero direct emission HDVs Low emission HDVs with specific direct CO₂ emissions <50% of the reference Co₂ emission of all vehicles in the same sub-group Dedicated vehicles solely using “advanced biofuels”, or “renewable liquid and gaseous transport of non-biological origin”, or certified low-ILUC biofuels in line with Directive 2018/2001
0.6	50 < gCO ₂ /km ≤ 60	50 <gCO ₂ /km ≤ 65	≥50% and <60%
0.7	60 < gCO ₂ /km ≤ 65	65 <gCO ₂ /km ≤ 80	≥60% and <70%
0.8	65 < gCO ₂ /km ≤ 70	80 <gCO ₂ /km ≤ 95	≥70% and <75%
0.9	70 < gCO ₂ /km ≤ 75	95 <gCO ₂ /km ≤ 110	≥75% and <80%
1.0	75 < gCO ₂ /km ≤ 80	110 <gCO ₂ /km ≤ 125	≥80% and <85%
1.1	80 < gCO ₂ /km ≤ 85	125 <gCO ₂ /km ≤ 140	≥85% and <90%
1.2	85 < gCO ₂ /km ≤ 90	140 <gCO ₂ /km ≤155	≥90% and <95%
1.3	90 < gCO ₂ /km ≤ 95	155 <gCO ₂ /km ≤ 170	≥95% and <100%
1.4	95 < gCO ₂ /km ≤ 100	170 <gCO ₂ /km ≤ 185	≥100% and <110%
1.5	gCO ₂ /km > 100	185 <gCO ₂ /km ≤ 200	≥110%

Taxonomy reference: for passenger cars and light commercial vehicles 24.5, for heavy duty vehicles 24.6; application to car mortgage, leasing and every other kind of product loan